NASA SBIR/STTR Technologies

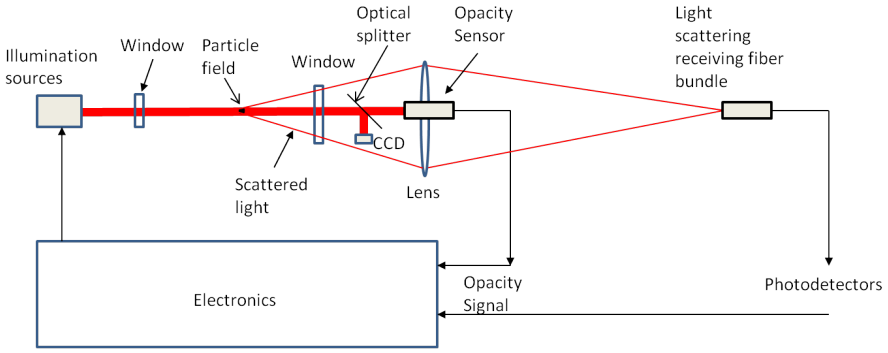
S1.07-8291 - Optical System for Atmospheric Particle Measurement

PI: Cecil Hess

MetroLaser, Inc. - Laguna Hills, CA

Identification and Significance of Innovation

NASA has stated a requirement to develop a compact particle characterization probe for atmospheric sensing on earth. The system must be small and of low power consumption commensurate with UAV operation. The particle size range of interest in atmospheric measurements is from about 0.1 µm to 200 mm and the particle composition may vary depending on altitude and geographical location. We will hold discussions with the technical monitors at the beginning of the contract to further define the measurement conditions. To address this measurement requirement we propose to combine two techniques: 1) Digital holography (DH) to measure the size, concentration and shape of particles larger than 5 µm, and 2) Forward Scattering Light Intensity (FSLI) to measure the size and concentration of particles from 0.1 µm to 5 µm. The two techniques work with small windows and have modest power requirements.



Estimated TRL at beginning and end of contract: (Begin: 2 End: 4)

Technical Objectives and Work Plan

The main objective is to demonstrate a measurement technique with broad particle sizing capability that can also be packaged in a miniature configuration with a low power consumption requirement, a necessary attribute for UAV operation. The proposed system will have the ability to measure particle size distributions from about 0.1 to 200 mm for a broad range of concentrations. The proposed system will yield an extremely small device, as stated in NASA's requirements. We will specifically pursue the following objectives: 1) Define measurement specifications in terms of anticipated particle size and concentration range, 2) Select optimum system configuration based on measurement specifications, environmental requirements, optical access, probe size, and power constraints, 3) Experimentally demonstrate ability to measure particle size from about 0.1 to 200 mm, and 4) Produce a conceptual design of a prototype system for Phase II development.
The Work Plan consists of analytical and experimental work to develop a miniaturized particle sizing measurement probe and demonstrate its measurement feasibility. A breadboard incorporating digital holography and light scattering will be developed and demonstrated under controlled laboratory conditions.

NASA Applications

Applications include characterization of particles in Earth atmosphere as well as environmental sensing of planetary and lunar missions. Other NASA applications include characterizing liquid water content in icing facilities, and measuring fuel spray distributions associated with gas turbines and other propulsion systems.

Non-NASA Applications

Commercial applications include measuring bio-aerosols (e.g. pollen, molds), characterizing droplet size and concentration in agricultural sprays, fire sprinklers, ink jet printers, diesel injectors, and numerous food processes. Military applications include vertical take-off aircraft inlet protection and ground based vehicle dust detection (e.g., tanks).

Firm Contacts

Cecil Hess
MetroLaser, Inc.
22941 Mill Creek Drive
Laguna Hills, CA, 92653-1215
PHONE: (949) 553-0688
FAX: (949) 553-0495